MULTIMEDIA UNIVERSITY

STUDENT ID NO.

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

BMD3024 – MULTIVARIATE DATA ANALYSIS

(All sections / Groups)

14 OCTOBER 2019
2.30 p.m. – 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **ELEVEN (11)** printed pages with **FOUR (4)** structured questions including the cover page.
2. Marks are shown at the end of each question.
3. Write all your answers in the answer booklet provided.
4. Answer **ALL** questions.

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Question One (25 marks)

(a) Explain **FOUR (4)** ANOVA situations and the related post-hoc tests that need to be performed.

(8 marks)

(b) In addition to the assumptions of all the models that you have learnt, discuss **FOUR (4)** other assumptions of MANOVA.

(8 marks)

(c) Describe the steps involved in reliability analysis in SPSS.

(9 marks)

Question Two (25 marks)

(a) Children wearing superhero costumes are more likely to harm themselves because of the unrealistic impression of invincibility that these costumes could create. For example, children have reported to hospital with severe injuries because of trying 'to initiate flight without having planned for landing strategies' (Davies, Surridge, Hole, & Munro-Davies, 2007). Data was collected about the *severity* of injury (on a scale from 0, no injury, to 100, death) for children reporting to the accident and emergency department at hospitals, and information on which superhero costume they were wearing *(hero)*: Spiderman, Superman, the Hulk or a Teenage Mutant Ninja Turtle.

ANOVA was run with post-hoc analysis to determine if any of the superhero costume are more likely to cause injury.

Table 1: Dependent Variable: Injury

Hero	Mean	Std. Deviation	N
Superman	60.33	17.851	6
Spiderman	41.63	12.212	8
Hulk	35.38	13.384	8
Ninja Turtle	26.25	8.155	8
Total	39.60	17.158	30

(i) Analyse the descriptive statistics in **Table 1** and determine which *Hero*'s costume is more likely, and least likely to cause severe injuries.

(4 marks)

Continued...

Table 2: Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	4180.62[a]	3	1393.54	8.32	0.00	0.49	24.95	0.98
Intercept	49402.17	1	49402.17	294.83	0.00	0.92	294.83	1.00
hero	4180.62	3	1393.54	8.32	0.00	0.49	24.95	0.982
Error	4356.58	26	167.56					
Total	55582.00	30						
Corrected Total	8537.20	29						

a. R Squared = .490 (Adjusted R Squared = .431)
b. Computed using alpha = .05

(ii) Analyse **Table 2** and determine if the *severity* of injuries suffered by children are significantly different depending on *Hero* costume type.

(4 marks)

Continued...

Table 3: Post-Hoc Tests

Type of Superhero Costume		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Superman	**Spiderman**	18.71	6.991	0.070	-1.05	38.46
	Hulk	24.96*	6.991	0.008	5.20	44.71
	Ninja Turtle	34.08*	6.991	0.000	14.33	53.84
Spiderman	**Superman**	-18.71	6.991	0.070	-38.46	1.05
	Hulk	6.25	6.472	0.907	-12.09	24.59
	Ninja Turtle	15.38	6.472	0.136	-2.96	33.71
Hulk	**Superman**	-24.96*	6.991	0.008	-44.71	-5.20
	Spiderman	-6.25	6.472	0.907	-24.59	12.09
	Ninja Turtle	9.13	6.472	0.650	-9.21	27.46
Ninja Turtle	**Superman**	-34.08*	6.991	0.000	-53.84	-14.33
	Spiderman	-15.38	6.472	0.136	-33.71	2.96
	Hulk	-9.13	6.472	0.650	-27.46	9.21

Based on observed means.
The error term is Mean Square (Error) = 167.561.
*. The mean difference is significant at the .05 level.

(iii) Based on the results in **Table 1** and **Table 3**, determine the *Hero* costume which causes the most severe injury.

(4 marks)

Continued...

(b) A researcher was interested in whether students' knowledge of different aspects of psychology improved throughout their degree. The researcher took a sample of first-years, second-years and third-years and gave them five tests (scored out of 15) representing different aspects of psychology: *Exper* (experimental psychology such as cognitive and neuropsychology); *Stats* (statistics); *Social* (social psychology); *Develop* (developmental psychology); *Person* (personality).

Table 4: Box's Test of Equality of Covariance Matrices[a]

Box's M	54.241
F	1.435
df1	30
df2	3587.253
Sig.	0.059

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.
a. Design: Intercept + group

(i) Refer to **Table 4** and determine if the assumption of homogeneity of covariance was violated, using 5 percent level of significance.

(4 marks)

Continued...

Table 5: Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	**Pillai's Trace**	0.960	159.166[b]	5.000	33.000	0.000	0.960
	Wilks' Lambda	0.040	159.166[b]	5.000	33.000	0.000	0.960
	Hotelling's Trace	24.116	159.166[b]	5.000	33.000	0.000	0.960
	Roy's Largest Root	24.116	159.166[b]	5.000	33.000	0.000	0.960
group	**Pillai's Trace**	0.510	2.330	10.000	68.000	0.020	0.255
	Wilks' Lambda	0.522	2.534[b]	10.000	66.000	0.012	0.277
	Hotelling's Trace	0.853	2.730	10.000	64.000	0.007	0.299
	Roy's Largest Root	0.773	5.255[c]	5.000	34.000	0.001	0.436

a. Design: Intercept + group
b. Exact statistic
c. The statistic is an upper bound on F that yields a lower bound on the significance level.

(ii) Refer to **Table 5** and determine if the variable *group* is a significant predictor for the dependent variate, using Hotelling's Trace statistic at 5 percent level of significance.

(3 marks)

Continued...

Table 6: Tests of Between-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	exper	18.430[a]	2	9.215	2.461	0.099	0.117
	stats	52.504[b]	2	26.252	2.967	0.064	0.138
	social	23.584[c]	2	11.792	1.941	0.158	0.095
	develop	37.717[d]	2	18.859	3.114	0.056	0.144
	person	39.415[e]	2	19.708	3.044	0.060	0.141
Intercept	exper	1428.058	1	1428.058	381.378	0.000	0.912
	stats	3093.775	1	3093.775	349.637	0.000	0.904
	social	3330.118	1	3330.118	548.129	0.000	0.937
	develop	3562.212	1	3562.212	588.250	0.000	0.941
	person	3273.395	1	3273.395	505.575	0.000	0.932
group	exper	18.430	2	9.215	2.461	0.099	0.117
	stats	52.504	2	26.252	2.967	0.064	0.138
	social	23.584	2	11.792	1.941	0.158	0.095
	develop	37.717	2	18.859	3.114	0.056	0.144
	person	39.415	2	19.708	3.044	0.060	0.141
Error	exper	138.545	37	3.744			
	stats	327.396	37	8.849			
	social	224.791	37	6.075			
	develop	224.058	37	6.056			
	person	239.560	37	6.475			
Total	exper	1609.000	40				
	stats	3584.000	40				
	social	3579.000	40				
	develop	3815.000	40				
	person	3537.000	40				
Corrected Total	exper	156.975	39				
	stats	379.900	39				
	social	248.375	39				
	develop	261.775	39				
	person	278.975	39				

a. R Squared = .117 (Adjusted R Squared = .070)
b. R Squared = .138 (Adjusted R Squared = .092)
c. R Squared = .095 (Adjusted R Squared = .046)
d. R Squared = .144 (Adjusted R Squared = .098)
e. R Squared = .141 (Adjusted R Squared = .095)

(iii) Referring to **Table 6**, analyse and report the results of the univariate effects of group on each of the dependent variables at 5% level of significance.
(6 marks)

Continued...

Question Three (25 marks)

(a) Zibarras, Port, and Woods (2008) looked at the relationship between personality and creativity. They used the Hogan Development Survey (HDS), which measures 11 dysfunctional dispositions of employed adults: being *volatile*, *mistrustful*, *cautious*, *detached*, *passive_aggressive*, *arrogant*, *manipulative*, *dramatic*, *eccentric*, *perfectionist*, and *dependent*. Zibarras et al. wanted to reduce these 11 traits down and, based on parallel analysis, found that they could be reduced to **THREE (3)** components. They ran a principal component analysis with varimax rotation.

Table 7: Rotated Component Matrix[a]

	Component		
	1	**2**	**3**
volatile		0.790	
mistrustful	0.271	0.681	0.241
cautious	-0.659	0.500	
detached	-0.279	0.181	0.765
passive_aggressive		0.170	0.617
arrogant	0.677		0.104
manipulative	0.785		
dramatic	0.833		-0.197
eccentric	0.549	0.299	0.154
perfectionist	-0.319		
dependent	-0.380	0.335	-0.639

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

Review **Table 7** and indicate the variables that belong in each of the **THREE (3)** components.

(11 marks)

Continued...

(b) The Dutch travel by bike much more than the English. A research noticed that many more Dutch people cycle while steering with only one hand compared to English cyclists. To put the hypothesis to the test he counted the number of Dutch and English cyclists who ride with one or two hands on the handlebars. (Note: Dutch and English are categories under the variable *Nationality*, while 'One Handed' and 'Two Handed' are categories under the variable *Hands*.)

Table 8: Nationality * Hands Crosstabulation

			Hands		
			One Handed	Two Handed	Total
Nationality	Dutch	Count	120_a	578_b	698
		Expected Count	110.0	588.0	698.0
		% within Nationality	17.2%	82.8%	100.0%
		% within Hands	87.6%	79.0%	80.3%
		% of Total	**13.8%**	**66.5%**	**80.3%**
		Standardized Residual	0.9	-0.4	
	English	Count	17_a	154_b	171
		Expected Count	27.0	144.0	171.0
		% within Nationality	9.9%	90.1%	100.0%
		% within Hands	12.4%	21.0%	19.7%
		% of Total	**2.0%**	**17.7%**	**19.7%**
		Standardized Residual	-1.9	0.8	
Total		Count	137	732	869
		Expected Count	137.0	732.0	869.0
		% within Nationality	15.8%	84.2%	100.0%
		% within Hands	100.0%	100.0%	100.0%
		% of Total	**15.8%**	**84.2%**	**100.0%**

Each subscript letter denotes a subset of Hands categories whose column proportions do not differ significantly from each other at the .05 level.

(i) Analyse the crosstabulation table above (**Table 8**) and determine the percentages of each category under the variable *Nationality* that cycle with one and two hands.

(4 marks)

(ii) Based on **Table 8**, is the assumption for chi-square met? Explain.

(3 marks)

Continued...

(iii) Compute the following odds based on **Table 8**:
   a. Someone riding one-handed if they are Dutch.
   b. Someone riding one-handed if they are English.

(2 marks)

(iv) What is the Odds Ratio of someone riding one-handed if they are Dutch versus if they are English? Explain your answer.

(2 marks)

Table 9: Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	5.437[a]	1	0.020	0.026	0.011	
Continuity Correction[b]	4.905	1	0.027			
Likelihood Ratio	5.958	1	0.015	0.019	0.011	
Fisher's Exact Test				0.019	0.011	
Linear-by-Linear Association	5.431[c]	1	0.020	0.026	0.011	0.006
N of Valid Cases	869					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 26.96.
b. Computed only for a 2x2 table
c. The standardized statistic is 2.330.

(v) Based on **Table 9**, is there an association between the variables *Nationality* and *Hands*? Explain your answer.

(3 marks)

Continued...

Question Four (25 marks)

(a) Felson and Bohrnstedt's (1979) studied 209 girls from sixth through eighth grade. They made measurements on the following variables (**Table 10**).

Table 10

Variables	Description
academic	Perceived academic ability, a sociometric measure based on the item Name who you think are your three smartest classmates
attract	Perceived attractiveness, a sociometric measure based on the item Name the three girls in the classroom who you think are the most good-looking (excluding yourself)
GPA	Grade point average
height	Deviation of height from the mean height for a subject's grade and sex
weight	Weight, adjusted for height
Rating	Ratings of physical attractiveness obtained by having children from another city rate photographs of the subjects

Develop **ONE (1)** path diagram that shows the following hypothesized structural relationships:

- Perceived academic performance (*academic*) is modeled as a function of *GPA* and perceived attractiveness (*attract*). (**H1** and **H2**)
- Perceived attractiveness (*attract*), in turn, is modeled as a function of perceived academic performance (*academic*), *height*, *weight*, and the rating of attractiveness by children from another city (*rating*). (**H3**, **H4**, **H5**, and **H6**)
- Also **correlate** *gpa*, *height*, *weight*, and *rating* with each other.

(13 marks)

(b) **Figure 1** below shows the outcome of the model from (a)'s fitting using SPSS AMOS.

Figure 1

ChiSquare=2.895
DF=3
ChiSquareDF=.965
p=.408
Ratio=.200
RMSEA=.000
TLI=1.002
CFI=1.000
AGFI=.968

Interpret **ALL** the model fit statistics found **Figure 1**. Is this a good model?

(12 marks)

End of Page